

# ESA SSA Space Weather Service System

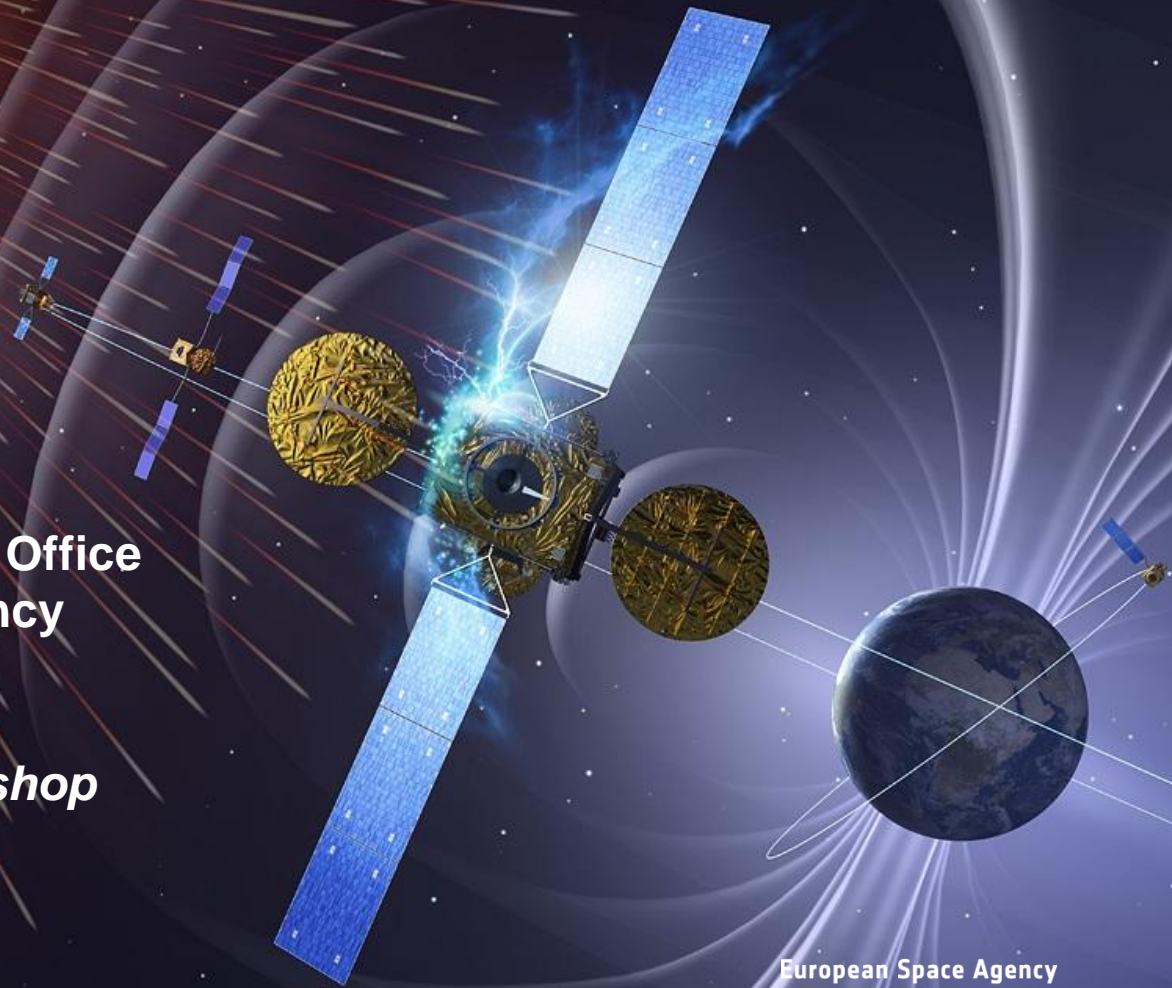
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European Space Agency

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*Boulder, Colorado*

[www.esa.int](http://www.esa.int)

European Space Agency



# PURPOSE OF THE SSA PROGRAMME



“The objective of the Space Situational Awareness (SSA) programme is to support the **European independent utilisation** of, and **access to, space** for research or services, through the **provision of timely and quality data**, information, services and knowledge regarding the **space environment**, the **threats** and the sustainable exploitation of the outer space **surrounding our planet Earth.**”



- ESA Ministerial Council  
November 2008



# ESA Space Situational Awareness (SSA) Programme



ESA SSA Programme has 18 Member States

- 13 member states in SSA P1
- 15 member states in SSA P2

Programme has three segments:

- Space Weather (SWE)
- Near Earth Objects (NEO)
- Technology R&D for Space Surveillance and Tracking (SST)

All SSA member states are participating SWE activities

SWE service developments are based on expertise and assets in the member states

=> federated service concept



# ESA SSA SWE Segment Objectives



## Detection and forecasting of the Space Weather events and its effects on European space assets and ground based infrastructure

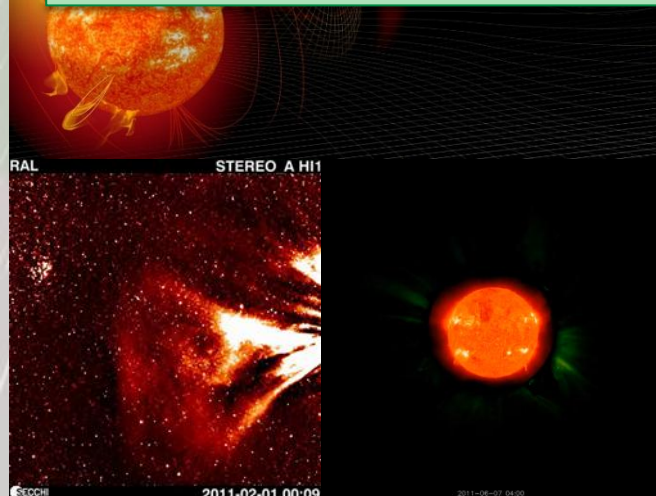
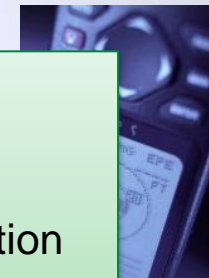
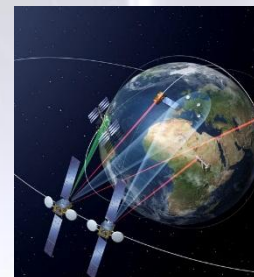
- Mission requirements
- Customer requirements
- System requirements
- Dialogue with the users
- Service reviews
- User raised tickets

Requirements,  
User feedback

SSA SWE system

Tailored  
services

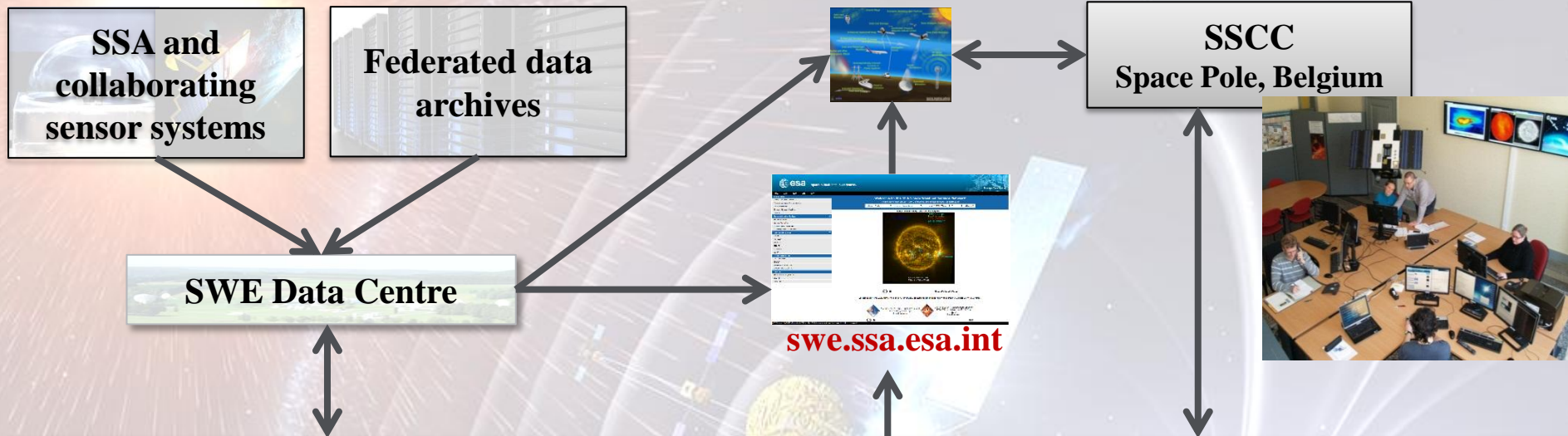
- User helpdesk
- Online tools and services
- SWE alerts
- Data and product dissemination
- Data archive
- Tailored SWE bulletins



# ESA SSA SWE System



## SSA-SWE Users



## SWE Expert Service Centres

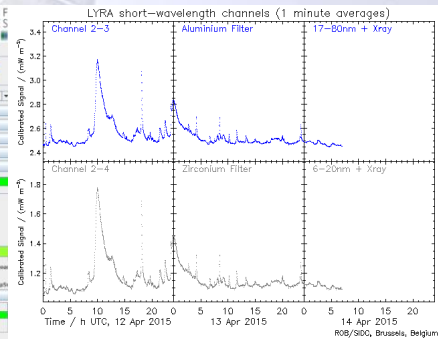
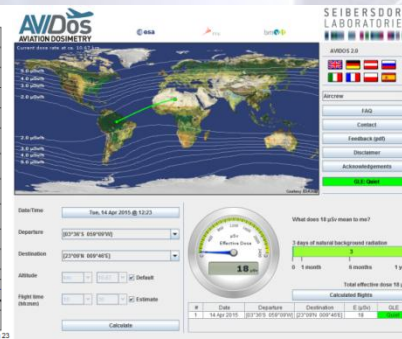
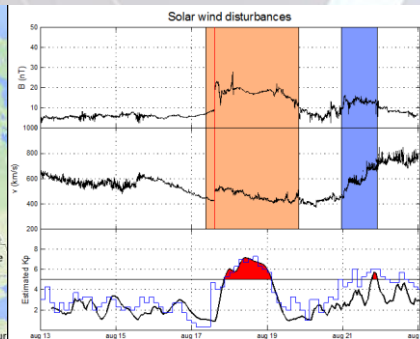
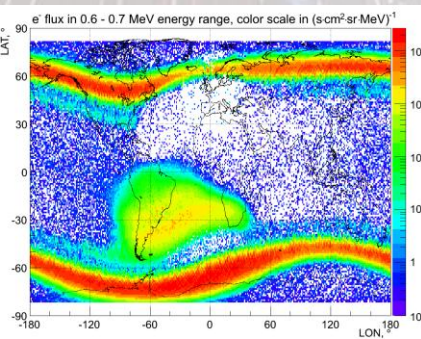
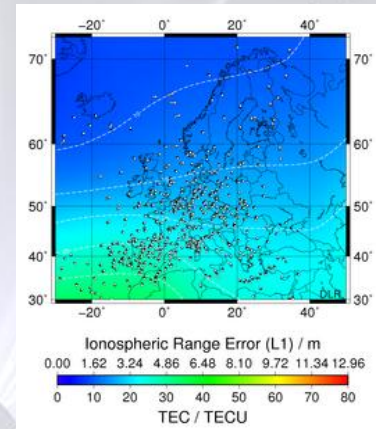
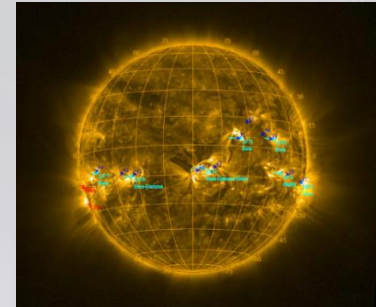




# Expert Service Centres (ESCs)



- ESCs are internationally distributed centres of expertise focussed on a specific SWE domain:
  - Solar Weather: Expertise on solar drivers of the space weather
  - Space Radiation: Expertise on radiation environment in space and for aviation
  - Ionospheric Weather: Expertise on the ionized upper layers of the atmosphere
  - Geomagnetic Conditions: Expertise on variations in the Earth's magnetic field
  - Heliospheric weather: Expertise on magnetospheric response to solar wind disturbances

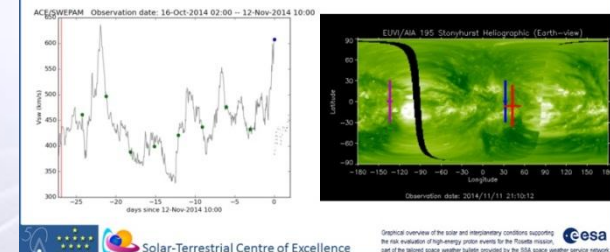
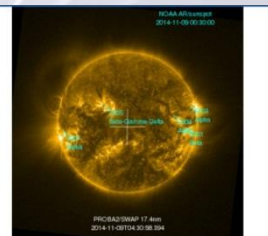
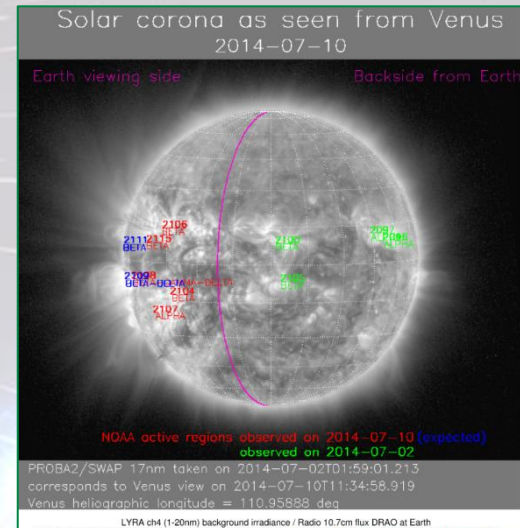


# SWE System in support of ESA missions



- Dedicated bulletins highlighting SWE network products and expertise, in support of ESA missions:

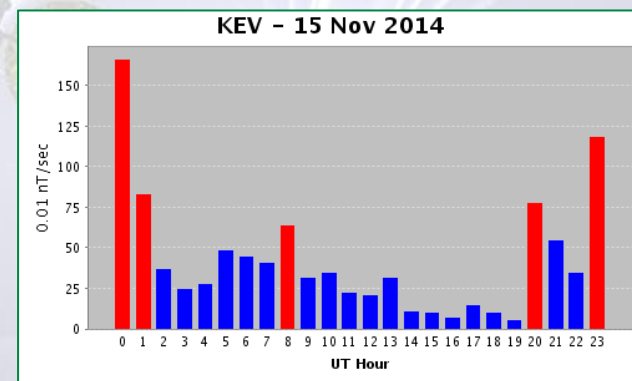
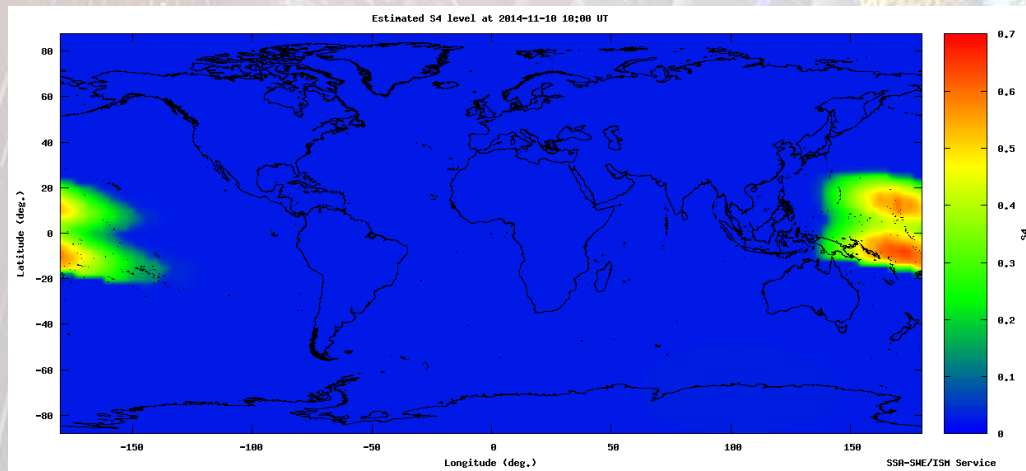
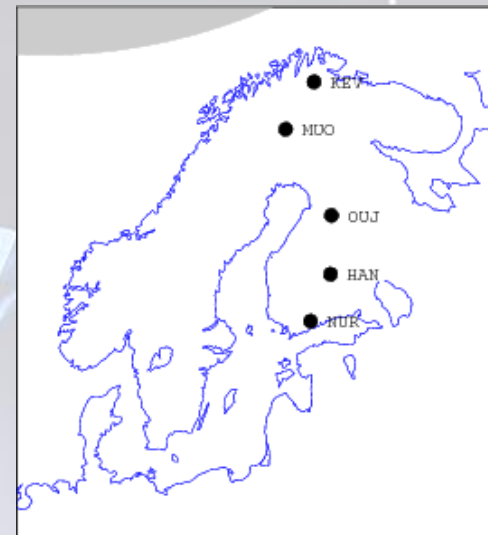
- GAIA: Launch and orbit insertion (Dec '13 – Jan '14)
- Venus Express: Aerobraking Campaign (May – Jul '14)
- Rosetta: Philae comet landing (12<sup>th</sup> Nov 14)
- Vega launch of IXV (Feb '15, capability demonstration)
- Preparations for LISA Pathfinder launch support in progress



# Service Prototypes in Final Acceptance



- DC-IV Space Weather (Prime: Etamax):
  - RAF: Regional Auroral Forecast (FMI):
    - Recent activity => Nowcast => 12hour Forecast
  - ISM: Ionospheric Scintillation Monitoring Service (IEEA/CLS)
    - Global & regional S4, Sigma-phi & TEC
    - Nowcast & 6 hour Forecast

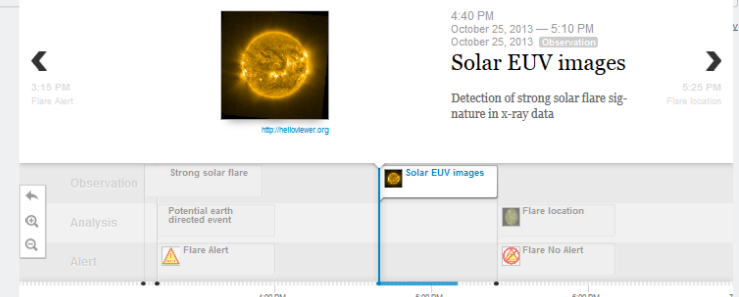
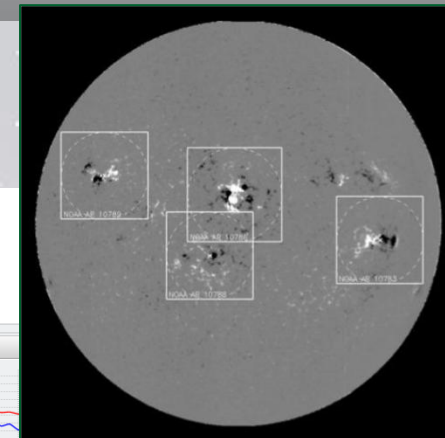
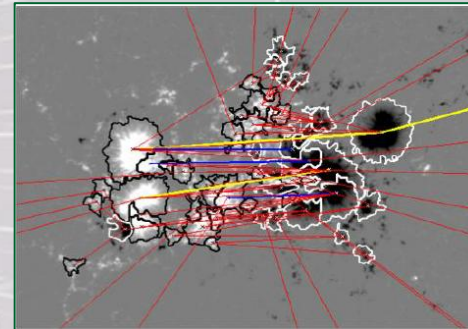




# Service Prototypes in Development



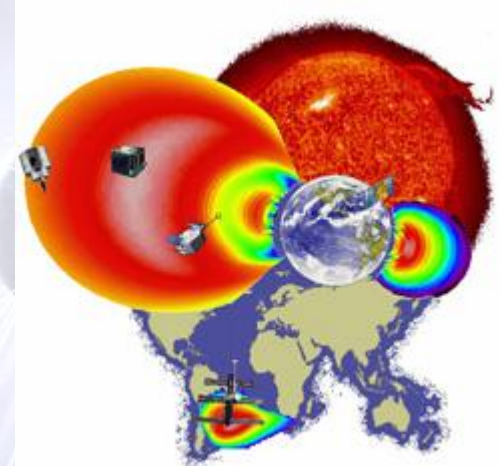
- SN-VI: SWE Service Developments
  - RESOSS: Service for Resource Exploitation (TGO/NMA)
  - SOLARDOS: Inclusion of SEP environment in AVIDOS application for aviation users (Seibersdorf)
  - SWTK: Space Weather Toolkit, data visualisation in support of forecasting (RHEA System)
- A-EFFort – Effective Flare Forecasting (Academy of Athens)
  - 24 hour forecast of major flare probabilities



# Upcoming Developments



- P2-SWE-II: Space Weather Service Developments (under evaluation)
  - Develop SSA/SST service domain
  - Solar & geomagnetic index nowcast & forecast, atmospheric modelling for drag assessment
- Further ITTs in 2015:
  - P2-SWE-XVI: SWARM utilisation analysis
  - P2-SWE-XIII: Advanced SWE service prototypes
  - P2-SWE-XIV: Virtual Space Weather Modelling Centre, Part 2

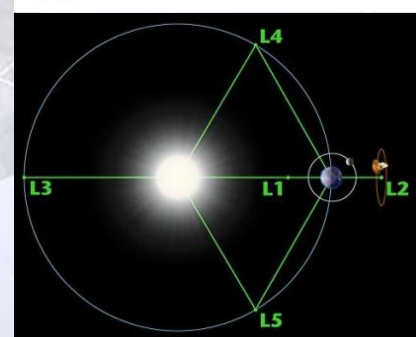
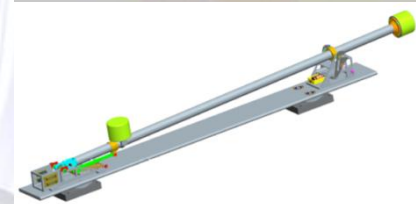
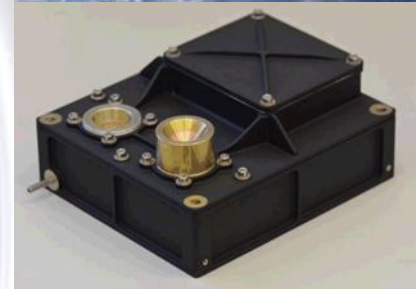




# SSA SWE Space Segment Development



- SSA Period 2 includes activities for
  - Operation of the PROBA-2 spacecraft
  - SWE instruments as Hosted Payload (HP)
    - NGRM/EDRS-C mission under implementation
    - SOSMAG/KSEM mission under implementation
    - Other HP missions to GEO MEO and LEO investigated
  - Phase C/D developments of SWE instruments for HP missions: hot plasma monitors, electron spectrometer, EUV imager, miniaturised radiation monitors, ...
  - Two parallel concept studies for operational SWE missions to L1 and L5
  - SCOPE: Prototyping of a compact coronagraph
    - Industrial contract to be started shortly



# SSA SWE Architecture Definition Studies



- Two parallel SSA SWE Segment architecture definition studies performed in 2012 - 2014
- Objective: Definition of a system capable of fulfilling all SWE Customer and System requirements
- Top-down approach
- Utilisation of existing assets considered in the second part of the study
- Study consortiums led by:
  - Airbus Defence and Space GmbH
  - OHB System AG





# SSA SWE Architecture Definition Results



- Analysis of the study results ongoing  
=> Definition of a consolidated SSA SWE architecture and an implementation roadmap
- Some initial observations from the study results:
  - In-situ observations in L1 are mandatory for SWE services
  - Dedicated SWE missions are needed for specific observations (e.g. solar imaging)
  - L5 (away from Sun-Earth line) is a potential way to improve SWE forecasting
  - Existing ground based observation system can be utilised, but complementing sensors are needed to fill gaps
  - Space segment is the cost drive for the system



- **Transition towards an operational system**
  - Integration of more European SWE assets into the system
  - SLAs with service and data providers
  - Development of new services in the framework of the SWE Expert Service Centres
- **Ensured long term availability of observation data**
  - SWE space segment development
  - Implementation of the first dedicated space weather satellite mission
  - Hosted payload missions of European SWE instruments
  - International collaboration and data exchange
- **Enhancement of the underpinning science for more reliable SWE forecasting**





**THANK YOU**

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